

WHAT IS CLAIMED IS:

1 1. A design support apparatus for a resin mold product
2 made of thermosetting resin, comprising:
3 a flow analysis means which analyzes a flow of
4 thermosetting resin injected into a resin filling cavity to mold
5 said resin mold product, using a finite difference method or a
6 finite element method;
7 a residual strain calculation means which calculates
8 residual strain (or stress) of the thermosetting resin after heat
9 shrinkage of the thermosetting resin injected into the resin
10 filling cavity to mold said resin mold product; and
11 a strength analysis means which analyzes strength of
12 said resin mold product, using a finite element method;
13 wherein:
14 said flow analysis means calculates a temperature, a
15 coefficient of elasticity and a strain (or stress) component of the
16 thermosetting resin at a time of heat curing, for each of first
17 three-dimensional solid elements used for flow analysis;
18 said residual strain calculation means uses
19 correspondence between each of second three-dimensional solid
20 elements used for strength analysis by said strength analysis
21 means and each of said first three-dimensional solid elements,
22 and the temperature, the coefficient of elasticity and the strain
23 (or stress) component calculated for each of said first
24 three-dimensional solid elements by said flow analysis means,
25 in order to set a temperature, a coefficient of elasticity and a

26 strain (or stress) component at the time of heat curing for each
27 of the second three-dimensional solid elements, and calculates
28 residual strain (or stress) after the heat shrinkage for each of
29 said second three-dimensional solid elements; and

30 said strength analysis means sets the residual strain (or
31 stress) after the heat shrinkage, which is calculated by said
32 residual strain calculation means, to said each of said second
33 three-dimensional solid elements, and analyzes the strength of
34 said resin mold product.

1 2. The design support apparatus for a resin mold product,
2 according to Claim 1, wherein:

3 said flow analysis means calculates changes of a
4 temperature and a reaction rate expressed as functions of time,
5 and a change of a viscosity expressed as a function of the
6 reaction rate, for each time step and for each of said first
7 three-dimensional solid elements, and further

8 for each of first three-dimensional solid elements whose
9 reaction rates reach a reaction rate of gelling, said flow
10 analysis means calculates the strain (stress) component at the
11 time of the heat curing, based on a relation between a reaction
12 rate and a specific volume, and calculates the coefficient of
13 elasticity at the time of the heat curing, based on relations of a
14 reaction rate and a temperature to a coefficient of elasticity.

1 3. The design support apparatus for a resin mold product,
2 according to Claim 1, wherein:

3 said residual strain calculation means sets a

4 representative point to each of said first three-dimensional
5 solid element and each of said second three-dimensional solid
6 element;
7 for each of said second three-dimensional solid elements,
8 said residual strain calculation means calculates averages of
9 temperatures, coefficients of elasticity and strain (or stress)
10 components of at least one of said first three-dimensional solid
11 elements whose representative points are close to a
12 representative point of a second three-dimensional solid
13 element in question, weighting said temperatures, said
14 coefficients of elasticity and said strain (or stress) components
15 according to distances of said representative points from the
16 representative point of said second three-dimensional solid
17 element in question; and sets the calculated averages as a
18 temperature, a coefficient of elasticity and a strain (or stress)
19 component to said second three-dimensional solid element in
20 question.

1 4. The design support apparatus for a resin mold product,
2 according to Claim 1 wherein:

3 for each of said second three-dimensional solid elements,
4 said residual strain calculation means calculates residual
5 strain, using the temperature, the coefficient of elasticity and
6 the strain (or stress) component set to a second
7 three-dimensional solid element in question, and using a
8 variation of coefficient of elasticity in a case where said
9 temperature is cooled down to a predetermined temperature.

1 5. A program readable by a computer, wherein:
2 when said program is executed on said computer, said
3 program implements the flow analysis means on said computer,
4 which is used in the design support apparatus of Claim 1 for a
5 resin mold product.

1 6. A program readable by a computer, wherein:
2 when said program is executed on said computer, said
3 program implements the residual strain calculation means on
4 said computer, which is used in the design support apparatus of
5 Claim 1 for a resin mold product.

1 7. A program readable by a computer, wherein:
2 when said program is executed on said computer, said
3 program implements the strength analysis means on said
4 computer, which is used in the design support apparatus of
5 Claim 1 for a resin mold product.

1 8. A method of supporting design of a resin mold product,
2 where a computer is used to support design of a resin mold
3 product made of thermosetting resin, comprising:
4 a flow analysis step in which a finite difference method
5 or a finite element method is used to analyze a flow of
6 thermosetting resin injected into a resin filling cavity to mold
7 said resin mold product;
8 a residual strain calculation step for calculating
9 thermosetting resin's residual strain (or stress) after heat
10 shrinkage of the thermosetting resin injected into the resin

11 filling cavity to mold said resin mold product; and
12 a strength analysis step in which a finite element
13 method is used to analyze strength of said resin mold product;
14 wherein:
15 in said flow analysis step, a temperature, a coefficient of
16 elasticity and a strain (or stress) component of the
17 thermosetting resin at a time of heat curing are calculated for
18 each of first three-dimensional solid elements used for flow
19 analysis;
20 in said residual strain calculation step, correspondence
21 between each of second three-dimensional solid elements used
22 for strength analysis in said strength analysis step and each of
23 said first three-dimensional solid elements, and the
24 temperature, the coefficient of elasticity and the strain (or
25 stress) component calculated for each of said first
26 three-dimensional solid elements in said flow analysis step are
27 used in order to set a temperature, a coefficient of elasticity
28 and a strain (or stress) component at the time of heat curing for
29 each of the second three-dimensional solid elements, and
30 residual strain (or stress) after the heat shrinkage is calculated
31 for each of said second three-dimensional solid elements; and
32 in said strength analysis step, the residual strain (or
33 stress) after the heat shrinkage, which is calculated in said
34 residual strain calculation step, is set to said each of said
35 second three-dimensional solid elements, and the strength of
36 said resin mold product is analyzed.